

# ODYSSEY OF OIL

Oliver Kuhn

*"Make thee an ark of gopher wood; rooms shalt thou make in the ark, and shalt pitch it within and without with pitch." Genesis 6:14*

Noah is instructed here to make his ark watertight by caulking it with pitch. In this context pitch refers to bitumen - thick, jellied crude oil. Although we tend to think of the oil industry as a recent phenomenon, the use of oil-based products was common in the Middle East in biblical times. In fact, archaeologists have unearthed artifacts that show human use of bitumen stretches as far back as at least 7,000 years ago.

This article looks at how and where ancient humans found oil and gas, explores some examples of ancient oil industries in North America and the Middle East, and finally tells the story of a relatively unknown culture whose existence was inextricably intertwined with the economics and politics of an ancient oil industry. It can be seen that systematic human exploitation of oil has gone on for a great deal longer than most people would expect, and that oil's political, economic, and cultural influence in ancient times was at times very similar to that of the present.

Humans have always shown a remarkable capacity for making use of any materials at hand. Anything the earth can offer - plant and animal life, wind, sun, etc. - is quickly exploited, and minerals, especially those found at the surface, are no exception. Human use of rocks and metals all began with those found at the surface, and over time methods were devised to extract those at depth. This is certainly the way that oil and gas use evolved. All over the world there are oil and gas seeps, but no region is as rich in surface extrusions of oil and gas as the Middle East, so it is this region that boasts the largest and most varied history of oil and gas exploitation.

## The New World - not so new

By no means is the historical use of oil and gas limited to the Middle East. Oil seeps are common in California, and the indigenous people here, the Yokuts, Chumash, Achomawi, Maidu, and Santa Barbara Channel Indians all made use of the oil from these seeps long before Europeans arrived in the region. Archaeologists have unearthed native use of petroleum products in the Santa Barbara area from 6,000 years ago. Tar was obviously very important in every day life, judging by the wide variety of purposes it was put to. Traditional uses for the bitumen included as an adhesive to attach stone tools to wooden handles or hold brush fibers together, as a coating for sewing string and fishing spears, even as chewing gum!

Two types of tar were available to the natives - sea borne tar (*malak*), and that found on land, *wogo*. Since the former was biodegradable it was less useful, so it was the *wogo* which was used more often. It was mined from seeps and pits, and then refined by

boiling. This improved its adhesiveness and made it a more effective waterproofer. Approximately 1,500 years ago the Santa Barbara natives developed the plank canoe or *tomol*. Living outside of the redwood region they were forced to use less than optimal lumber, and tar caulking was critical in sealing ill-fitting planks. The *tomol* allowed natives to fish a greater area, and to increase the scope of their trade with neighbouring tribes.

Besides using it as a source of boat caulk, the Spaniards failed to capitalise on the oil wealth of coastal California. However, settlers in the 1800's quickly took advantage of the oil seeps, and oil was

mined for use as a lubricant, road pavement, and lamp fuel. These oil miners had often gained their expertise in the gold rush, so hard rock mine shaft techniques were often used. Eventually wells were drilled down-dip of the seeps, and many large Californian discoveries were made this way, from the Newhall field in 1876 to the Livermore field in 1976.

The Californian seeps are typical. Oil and gas contained in a reservoir at depth can leak out, and follow the rock bedding up-dip to where it outcrops at the surface (Fig. 1). Oil seeps are analogous to water springs, but rather than water, liquid and gaseous hydrocarbons leak out of the ground. Most of the lighter components of the oil are usually lost to evaporation, and the remaining heavier components further biodegrade and oxidise at the surface, eventually becoming thick and tar-like. This substance is referred to as bitumen, pitch, tar, or asphaltum. In some instances methane, ethane, propane and other flammable gases can seep out - there is one seep located in Humboldt County where locals roast marshmallows!

As an interesting aside, these very same oil seeps are often the mistaken cause of concern in environmentally hypersensitive California. Offshore wells or oil tankers are often blamed for the tar washed up on the beach, when the source is actually one of many prolific offshore oil seeps. The approximately 250 seeps off of Coal Oil Point near Santa Barbara release approximately 150 barrels of oil per day (~55,000 per year) into the ocean. In 1982 a group headed by Mobil and Arco positioned two 50-foot high steel pyramids over a major seep area. These huge tent-like structures capture the escaping hydrocarbons, at a rate estimated to be the equivalent of 35,000 cars'

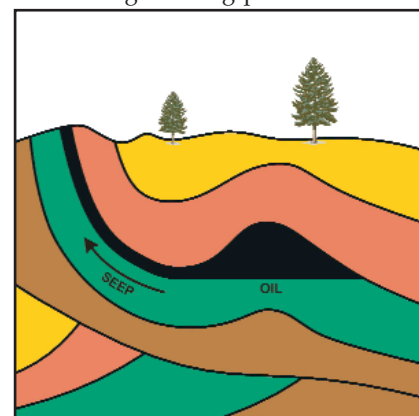


Figure 1 "Oil seep geology"



emissions. It is ironic to learn that commercial oil and gas production from Californian fields lowers the pressure driving many oil seeps, thus actually reducing the amount of pollution from seeps.

As a further digression into modern times, it can be mentioned that marine oil seeps, like those off California, are being used today worldwide to locate new oil and gas reservoirs. Satellite images can detect oil slicks on the surface of bodies of water. Two imaging techniques are used, spectral and textural. Oil slicks increase reflectance in the visible through near-infrared portion of the electromagnetic spectrum. Oil slicks also will smooth the water surface, reducing sun glint (or glitter) and thus radar backscatter.

Onshore oil seeps are extremely obvious - black, often with a sulphurous odour (Fig. 2) - and the bitumen is easily worked and transported. Even primitive early humans must have immediately found many uses for the substance. Figure 3 is a photo of a famous oil seep in Trinidad known as Pitch Lake. This circular lake of asphaltum covers an area of 100 acres (40 hectares) and is 75 m deep at the centre. Its reserves of 6-10 million tonnes will last for 400 more years at the present rate of extraction. The seep here is the result of a different geological setting than those of California. Shale diapirs throughout Trinidad have resulted in "mud volcanoes", substantial hydrocarbon traps, and in this case, a path for oil to seep to the surface.

As soon as Sir Walter Raleigh "discovered" Pitch Lake in 1595, it was exploited commercially. He caulked his ships with its tar, and commented that the quality was "most excellent goode." It quickly became favoured over Norwegian pitch because of its superior quality, and in the 400 years since then has been exported widely, mainly for use as road asphalt. Last year the company mining Pitch Lake exported to over 50 countries, grossing over US\$3m. The indigenous people of Trinidad, the Chaima, believed that the lake was the remains of a village that was swallowed up by the earth, a punishment from angry gods. All that remains of them is a bit of pottery in the tar. The indigenous people of the Caribbean were wiped out soon after contact with the Europeans by genocide and disease, and we

have little knowledge of their culture. However, it would be hard to imagine that they did not use Pitch Lake as a source of boat caulk, in a region where inter-island travel is crucial to economic survival.

In 1859 Colonel Drake drilled the first oil well in Titusville, Pennsylvania. This region has numerous oil seeps, and supported large-scale oil gathering efforts for hundreds of years. These seeps are no longer evident, since the reservoirs which fed them have been pressure depleted. Early oil pioneers would build baffles and dams in streams and ponds, and then skim the oil off the surface. It was then transported by foot, horseback or raft to Pittsburgh and sold. In 1790 oil would fetch \$200 per barrel in today's dollars.

While these crude early efforts are very interesting, it is more fascinating to learn that natives were collecting oil from this very same region, at a fairly large scale, before the arrival of the Europeans. Large pits, between 7 and 35 feet long, 6 to 10 feet deep, were dug to act as collecting ponds. Some of the larger ones were shored up with vertical timbers. These timbers have been radiocarbon dated to 1415-1440 AD.

## The Middle East - birthplace of the modern oil industry

It is in the Middle East (Fig. 4) where most evidence of ancient oil industries is found, and indeed this region in the past was technically far advanced relative to the European west, with many oil refining techniques originating here. Archaeological evidence from the Ubaid culture (near Ur, southern Iraq) of approximately 7,000 years ago shows that these people used bitumen to caulk their boats, and to attach decorative inlays to works of art. Akkadian clay cuneiform tablets from 2200 BC use the word *naptu* when referring to crude oil. The evolution of this word into the Arabic *naft*, and hence our naphtha is quite obvious. The Mesopotamian cultures of Sumeria, Babylonia, and Assyria all used oil products in day-to-day life. Large and impressive cities were built with bricks strengthened by the addition of bitumen, and held together with bitumen mortar; sophisticated and extensive irrigation systems used bitumen as a caulk; marine vessels were made watertight with bitumen; oil derivatives were used for various medicinal



Figure 2 "Oil seep"



Figure 3 "Pitch Lake, Trinidad"



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(Courtesy Catherine Garden, Pfang Creative)

Figure 4 "Middle East"

purposes, including as a laxative. This may be useful information for constipated well site workers!

While describing the splendours of Babylon in his Histories, Herodotus (born ~484 B.C.) goes into some detail about its brickwork. "... then using hot bitumen for mortar the workmen began by revetting with brick each side of the moat, and then went on to erect the actual wall."

The ancient Greeks certainly had knowledge of the lands to their east and the many oil seeps found there, and there are numerous references in classical Greek literature to eternal flames or fires, places where humans or lightning strikes had ignited the escaping gases at an oil seep. These locations were given religious or spiritual importance, and acted as shrines or pilgrimage sites, most notably for the Zoroastrians. Zoroastrianism was a dominant religion in Persia beginning about 1700 BC, and fire as a symbol played an important role. Temples, *ateshkadeh* in Persian, always contained a fire, and some linguists believe the "as" in Zoroaster derives from the root for fire. It is likely that oil products were burned in these temples, or the temples were situated at "eternal flames". Incidentally, the three wise men in the story of the birth of Christ were Zoroastrians. Major oil seeps were found throughout the region: the shores of the Persian Gulf, along the Euphrates River, and further north in the Caucasus region, significantly in modern-day Baku. The ancient Persian word *aberdagan*, meaning "garden of fire", remains with us as Azerbaijan.

In Marco Polo's accounts of his travels, beginning 1271 AD, there

are some observations of oil seeps somewhere near Baku. "Near the Georgian border there is a spring from which gushes a stream of oil, in such abundance that a hundred ships [1,000 camels in another surviving version] may load there at once. This oil is not good to eat; but it is good for burning and as a salve for men and camels affected with itch or scab. Men come from a long distance to fetch this oil, and in all the neighbourhood no other oil is burnt but this."

In Plutarch's history of Alexander the Great, he describes Alexander's advance into Babylonia (~335 B.C.) following the defeat of Darius and the Persian army. "On his march he was particularly impressed by the fissure in the earth from which fire continually poured forth as if it came from a well, and by the stream of naphtha which gushed forth so abundantly that it formed a lake not far from the chasm. This naphtha is in many ways like bitumen, but is so inflammable that a flame can set it alight by its very radiance without actually touching it, and it often kindles all the intermediate air." Further comments indicate the locals were comfortable with handling the naphtha, and stored and transported it for various purposes.

It is obvious why this oily region, with its easily accessible surface oil, became the birthplace of the modern oil industry. While Europe descended into its Dark Ages, the Middle East experienced a flowering of wealth, technology and culture, sometimes referred to as the Islamic Renaissance. Oil played an important role in all aspects of this period - economics, medicine, science and technology, warfare and politics. It is perhaps due to deep-rooted cultural and religious differences that we in the west are largely ignorant of the achievements of these cultures. Many concepts and technologies we consider European were in fact developed hundreds of years earlier in the Middle East, and only later moved westward via avenues such as the Crusades, Moorish occupation of Spain, westward Ottoman expansion, and of course increasing trade between Europe and the Middle East.

Following the Prophet Muhammad's death in 632, the Arabs expanded fairly quickly to the north and east. They found hundreds of oil pits being actively worked throughout Persia. The oil industry was already fairly sophisticated by that point, but it is only from the time of the Arab conquest and onwards that we have extensive and accurate written documentation.

There is a great deal of evidence that the Islamic cultures made military use of oil, with a variety of incendiary devices. The mysterious Greek fire was most likely the Byzantine naval adaption of Arabic land-based military technology. It is suggested that around 675 AD a Damascus man with knowledge in the military use of naphtha defected to Byzantium (subsequently Constantinople, now Istanbul). The secrets he passed on allowed the Greeks to outfit their fleet with "fire spouting devices". These were most likely siphon-like devices which squirted naphtha onto enemy boats, which could then be ignited. In 680 AD at the Battle of Kyzikos, this technology



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allowed the Byzantines to break the Muslim siege and destroy the Muslim flotilla, a navy which up to that point had been far superior.

In 683 AD the holy city of Makkah (Mecca) was attacked by an army using incendiary devices hurled by catapults and mangonels. At one point the cloth covering the Ka'bah caught fire, and the rock itself was split by the heat. The early Muslims mined the eastern mountains of Central Asia in the vicinity of today's Tajikistan for asbestos. Among other uses, the asbestos was woven into fire and heat resistant suits for the *naffatun*, or naphtha troops, and their horses. Over the next few hundred years there are numerous instances of cities being attacked and burned with naphtha pots, Molotov cocktail-like devices which were hand or mangonel thrown. The remnants of hundreds of these naphtha pots have been unearthed in Cairo, most likely from an attack on the city in 1167 AD. Analysis of these pots indicates that the tops were blown off by a lethal combination of kerosene, nitrates and sulfur, the basic ingredients of gunpowder.

The military use of oil derivatives gives us a good estimation of the level of ancient oil technology expertise. But oil expertise was not limited to warlike applications. 10th century records show that the Persian province of Faris paid an annual tribute of 90 metric tons of oil to light the palace of the Caliph, and indeed oil products were used throughout the region for heat and light. Asphalt was produced on a large scale for the purpose of paving roads. Large iron kettles were used to mix prescribed measurements of bitumen, sand and water, while being heated and stirred. This was being done perhaps a thousand years prior to the paving of Europe's first asphalt road, in Paris 1838. The industrial use of oil in the Middle East was an important part of the economy, and governments from the early 9th century on typically appointed a *wali al-naft*, or oil minister, in each oil producing region to control, regulate and tax the oil industry. It can be said with great certainty that resentment to centrally imposed taxes on oil producing regions is not a new thing.

Around the year 850 AD the medieval Arabs developed the process of distillation, allowing the production of kerosene, widely used as lamp oil. The vessel used was called *al-inbiq*, which survives in English as alembic. Incidentally, the distillation of alcohol, resulting in high proof liquors, was also an Arab invention; the word alcohol is derived directly from the Arabic *al-kuhul*. While the European barbarians were quaffing mead and ale and other low test drinks, in the Middle East they were sipping liqueurs! Other

words beginning with "al", such as algebra, give away their Arabic roots - "al" is "the" in Arabic. Some *al-inbiqs* were large size industrial oil refining distilleries, and the city of Damascus in the 13th century had its own distillers market, the Suq al-Qattarine. The kerosene refining process allowed areas with oil-rich shales but no crude oil seeps to develop their own small-scale kerosene industries.

## The Nabateans - ancient culture, modern problems

The story of the Nabateans neatly encapsulates how many parallels today's oil industry has with the distant past. Many of the same elements found in present day oil news can be found in the history of these people who lived over 2,000 years ago - power and wealth based on oil revenue, political intrigue, supply and demand economics, and sadly, the use of military might to acquire oil revenue.

The Nabatean culture lived on the southern fringes of the great Middle Eastern arena, with its grandiose struggles between the Greeks and Persians. Originating in northwest Arabia, their kingdom eventually encompassed the Negev Desert, the Dead Sea, and most of modern-day Jordan. Their economy was based on the trade route that linked southern Arabia with Egypt. Large parts of their territory were desert, and they were to a large extent nomadic. It was only in the latter part of their history that they developed significant urban centres. These factors most likely contributed to the minimal historical records of their culture. Their most famous legacy is the city of Petra (Fig. 5), in modern day Jordan, south of the Dead Sea. Most people will remember

Petra as the city carved out of rock featured in the movie *Raiders of the Lost Ark*. This magnificent site was misinterpreted by early archaeologists eager to find physical proof of cities mentioned in the Bible. However, scholars have now pieced together a probably accurate history of these very interesting people.

Trade routes between southern Arabia and Egypt have existed for thousands of years. The ancient Egyptians imported spices, incense, and also aromatic resins used in their mummification process from Arabia. Sometime around the 4th or 5th century BC, the Egyptian population was nearing 6 million people, and the supply of aromatic resins could no longer meet the demand. Priests began to add bitumen to the resins to increase the volume, and eventually this created a large demand for bitumen. The resin and or bitumen was used to glue together the many layers of linen which wrapped the mummies. The Nabateans filled this

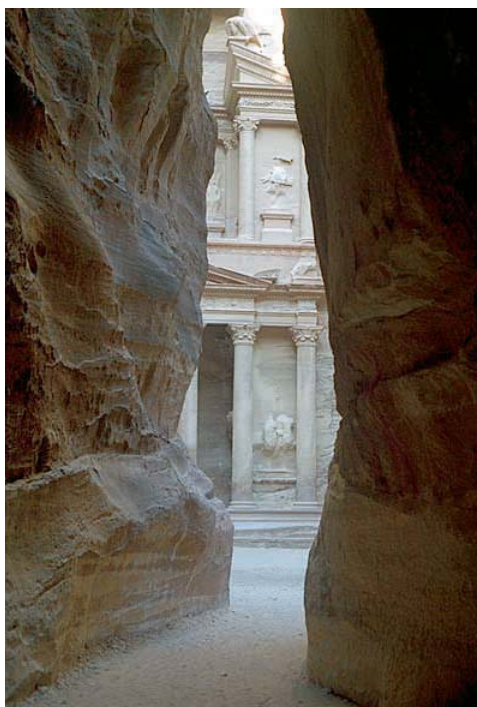


Figure 5 "Siq Khazneh, Petra, Jordan"

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demand, and this is where the story of their Dead Sea oil industry comes in.

In 312 BC two of Alexander the Great's former generals, Ptolemy I Soter and Antigonus I Monophthalmos (the One-Eyed), were fighting each other in an attempt to gain control of the Middle East. Antigonus sent one of his generals, Hieronymus of Cardia, to expel the Nabateans and gain control of the Dead Sea oil industry. When Hieronymus and his army reached the southern end of the Dead Sea, they found many Nabateans camped on the shore. They were waiting for the appearance of what they called *thawr*, Arabic for bull, in the waters of the Sea. The "bulls" were big chunks of bitumen which would float to the surface. "They make ready large bundles of reeds and cast them into the sea. On these not more than three men take their places, two of whom row with oars, which are lashed on, but one carries a bow and repels any who sail against them from the other shore, or who venture to interfere with them. When they come near the floating bitumen they jump upon it with axes and, just as if it were soft stone, they cut pieces and load them onto the raft, after which they sail back."

To make the bitumen transportable, women and children would then sprinkle it with sand, and load it into leather bags on camels. These camel caravans would then head south through the Wadi Araba to Petra, then northwest to the coast near present-day Gaza. From there the bitumen was taken by land or sea to Alexandria, on the Nile delta.

Hieronymus' attempt to take over the "oil fishery" was unsuccessful. The Nabateans sent out 6,000 men and attacked the Greeks. Antigonus' larger attempt to conquer the Nabateans and impose an economic blockade on Egypt from the east was also unsuccessful. After finding the Nabateans more difficult to subdue than expected, mainly because of Petra's well built fortifications and the hostile desert surroundings, the Macedonian negotiated a withdrawal. Ptolemy I Soter solidified his hold on Egypt, founding a dynasty, and building the famous library in Alexandria.

The Nabateans appear to have conducted their lucrative trade with Egypt for the next 200 years or so, and maintained their monopoly on the Dead Sea bitumen. This period was evidently very profitable, as the magnificent city of Petra was largely built during this time, and the Nabateans extended their territory north into Syria. It was just a matter of time before their wealth would attract the attention of covetous eyes. In 88 and 87 BC, the Seleucid king Antiochus XII attempted to gain control of the Nabatean oil industry, but failed, dying in the decisive battle near the Dead Sea.

Some 20 years later the Romans turned their massive military attentions to Egypt, and the territories that lay between Egypt and their Middle Eastern base in Syria. In 62 BC a Roman officer named Scaurus only withdrew from Nabatean territory after being paid a large ransom in silver. This tactic of military threat and payoff was

repeated until the famous Roman Marc Antony annexed the Nabatean kingdom outright and seized control of the oil fishery.

Marc Antony's consort, the Greek-Egyptian queen Cleopatra VII is still famous for her beauty and charm, but she evidently had a keen business sense too. She persuaded Marc Antony to give her the oil fishery as a gift, and she subsequently leased it back to the Nabateans for 200 talents a year, or roughly US\$400,000, a massive sum in those days. It has been remarked that this is the earliest historical reference to a lease-back scheme. Cleopatra's intention was to use the revenue from the oil operations to finance the building of a naval fleet for Antony, which he would use to defeat his Roman rival Octavian.

Cleopatra's all too familiar use of oil as an endless source of revenue set into motion a sequence of events which had tragic consequences for her and her lover. The Nabateans, forced to pay out ever more for producing a resource they considered theirs, eventually stood up to the Egyptians and refused to pay. Antony responded by sending a punitive force against them, led by his Judean ally King Herod. The Nabateans defeated Herod at the battle of Qanawat (present day Syria) in 32 BC, and the next year Antony and his fleet were defeated in a sea battle off Actium.

Seeing no way out, and surrounded by hostile forces, Antony and Cleopatra attempted a desperate escape. They had several ships dragged across the relatively narrow strip of land separating the Nile from the Red Sea, with the intention of sailing to India. Unfortunately for the Egyptian queen, they were set upon by a Nabatean fleet, who remembering their treatment by Cleopatra, set her boats on fire. The ill-fated couple scrambled back to Alexandria, where feeling all was lost they committed suicide.

With Antony and Cleopatra out of the way, Octavian made Egypt a Roman colony, and outlawed the practice of mummification. This greatly reduced the demand for Dead Sea bitumen. The Nabateans continued on with their oil trade, now mainly supplying medicinal needs, but their heyday of oil wealth was over, and they were eventually absorbed by the province of Roman Arabia and disappeared from view.

Most of us CSEG members are directly employed by the oil industry. We live in a world culture which is totally reliant on oil. Without oil and all its byproducts, our economy, our culture, our society would not exist. It is fascinating to look back at other cultures and realise that many of the oil-related issues we struggle with now are not new, and that oil has been helping people improve their quality of life for thousands of years. It brings to mind the old saw, "The more things change, the more they stay the same."

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